

REMARKS

The Examiner is thanked for the interview courteously granted to the undersigned, in connection with the above-identified application. During this interview, the undersigned indicated that claim 1 would be amended to recite a maximum amount of hydrogen fluoride of 4.5 mol; and, based thereon, discussed differences between the present invention and the teachings of the applied prior art. Specifically, it was pointed out by the undersigned that the applied prior art describes a molar ratio of HF of at least 5, and thus would have taught away from the amount of hydrogen fluoride of 2.5-4.5 mol. In addition, during the interview it was emphasized that problems of steric hindrance, at the site to be formylated, arises in formylating polyalkyl-substituted aromatic compounds having 3-5 alkyl groups, which is a problem addressed by the present invention, this problem being overcome by restricting the amount of hydrogen fluoride; and it was pointed out that such problem would have neither been disclosed nor would have been suggested by the teachings of the applied prior art. Moreover, not only would such problem not have been disclosed nor suggested by the applied prior art, the solution thereto (of restricting maximum amount of hydrogen fluoride) would have neither been disclosed nor suggested by the applied prior art. During the interview, it was pointed out that a Declaration would be submitted showing problems arising in connection with polyalkyl-substituted aromatic compounds having 3-5 alkyl groups, as compared with alkyl-substituted aromatic compounds having less than three alkyl groups as substituents.

Applicants have amended their claims in light of discussions during the aforementioned interview, and so as to further clarify the definition of various aspects of the present invention. Specifically, claim 1 has been amended to recite that the amount of hydrogen fluoride is 2.5-4.5 mol, based on 1 mole of the polyalkyl-substituted aromatic compound. Note, for example, the first full paragraph on page 4 of Applicants' specification.

In addition, Applicants are adding new claims 6-9 to the application. Claim 6, dependent on claim 1, further defines the amount of hydrogen fluoride, as being 3.0-4.5 mol based on one mole of the starting polyalkyl-substituted aromatic compound. Claims 7 and 8, dependent respectively on claims 6 and 1, further define the amount of boron trifluoride; and claim 9, dependent on claim 1, defines the polyalkyl-substituted aromatic compound as being selected from a specific group thereof. In connection with new claims 6-9, note, for example, pages 3-5 of Applicants' specification.

Applicants respectfully submit that all of the claims now presented for consideration by the Examiner patentably distinguish over the teachings of the reference applied by the Examiner in rejecting claims in the Office Action mailed May 6, 2004, that is, the teachings of U.S. Patent No. 4,460,794 to Fujiyama, et al., under the provisions of 35 USC §102 and 35 USC §103.

It is respectfully submitted that this reference as applied by the Examiner would have neither taught nor would have suggested such a process for producing a polyalkyl-substituted aromatic aldehyde as in the present claims, including, inter alia, wherein the formylation takes place in the presence of, inter alia, hydrogen fluoride,

the amount of hydrogen fluoride being 2.5-4.5 mol based on one mole of the polyalkyl-substituted aromatic compound. See claim 1.

Moreover, it is respectfully submitted that the teachings of this applied reference would have neither disclosed nor would have suggested such process as in the present claims, having features as discussed previously in connection with claim 1, and, further including (but not limited to) wherein the formylation is conducted at -30 to 40°C under a pressure of 1-3 MPa (see claim 2); and/or wherein the amount of boron trifluoride is that set forth in claim 1, more particularly that set forth in claims 7 and 8; and/or wherein the polyalkyl-substituted aromatic compound is at least one compound selected from those set forth in claims 3-5 and 9.

The present invention relates to a process for producing polyalkyl-substituted aromatic aldehydes having three or more C₁-C₃ alkyl groups, useful as raw materials or intermediate materials for production of medicines, agricultural chemicals, perfumes, etc.

In the formylation of the alkyl-substituted aromatic compounds in the presence of hydrogen fluoride/boron trifluoride catalyst, the reaction is extremely slow if the alkyl-substituted aromatic compound has, in the case of mesitylene or isodurene, alkyl groups on both the carbon atoms adjacent to the site to be formylated. More specifically, the formylation of alkyl-substituted aromatic compounds having alkyl groups on both the carbon atoms adjacent to the site to be formylated requires an extremely high carbon monoxide pressure of 10 MPa or higher and/or a very long reaction time, making the process industrially disadvantageous. Note the paragraph bridging pages 1 and 2, and the last full

paragraph on page 2, of Applicants' specification.

Against this background, the present inventors have found that the formylation of the alkyl-substituted aromatic compounds having 3-5 C₁-C₃ alkyl groups proceeds under mild conditions with a sufficient formylation rate, and without causing precipitation of solid matters, by restricting the amount of HF. That is, as described on page 5 of Applicants' specification, steric hindrance on the site to be formylated is expected to be relieved by reducing the amount of excess hydrogen fluoride, thereby increasing the rate of formylation. Note, in particular, page 4, line 27 through page 5, line 15, of Applicants' specification.

Fujiyama, et al. discloses a process for continuously producing alkylbenzaldehydes by formylating alkylbenzenes with carbon monoxide. This patent discloses that an alkylbenzene is continuously fed to a reactor containing a reaction mixture containing HF-BF₃, into which CO is introduced under a partial pressure of at least 5 kg/cm² absolute. Note column 1, lines 8-12, and column 2, lines 45-49. This patent goes on to disclose that the molar ratio of HF to the feed alkylbenzene is particularly important and must be at least 5, preferably 7 or higher, but a molar ratio above 15 is not necessary. See column 3, lines 22-25. See also column 3, lines 5-8. With respect to reaction temperature, note column 3, lines 48-53; with respect to use of, e.g., mesitylene, among other compounds, as raw materials in the reaction, see column 4, lines 5-18.

It is emphasized that Fujiyama, et al. mandates a molar ratio of hydrogen fluoride of at least 5. It is respectfully submitted that the disclosure of this patent would have neither taught nor would have suggested the presently claimed process,

including an amount of hydrogen fluoride of 2.5-4.5 (which, of course, is below 5).

Moreover, it is respectfully submitted that Fujiyama, et al. would have neither disclosed nor would have suggested the other features of the present invention as in the dependent claims, having the features of claim 1 as discussed previously.

In addition, it is noted that Fujiyama, et al. discloses in column 4, lines 5-18, various raw material compounds including, inter alia, mesitylene. However, it is respectfully submitted that the examples of this patent do not include use of mesitylene. Moreover, it is respectfully submitted that this reference does not disclose, nor would have suggested, the additional problems arising with respect to formylation of polyalkyl-substituted aromatic compounds having 3-5 alkyl groups on their aromatic ring, as described according to the present invention, and avoidance of such additional problems as achieved according to the present invention.

With respect to the additional problems, attention is respectfully directed to the enclosed Declaration Under 37 CFR § 1.132. In this Declaration, executed by one of the named inventors in the above-identified application, experiments were carried out in order to compare performance of formylation using HF-BF₃ catalyst of a polyalkyl-substituted compound having 3-5 C₁-C₃ alkyl groups, with that of a polyalkyl-substituted aromatic compound having one or two alkyl groups. The experiments are described on pages 2-4 of the enclosed Declaration. Results of the experimentation are shown on pages 4 and 5 of the Declaration. As can clearly be seen in the graphs on page 5, with increase of HF the conversion and yield of mesitylene (a raw material within the scope of the present claims) decreased, while as HF increased the conversion and yield of o-xylene and ethylbenzene increased,

at least to a molar ratio of HF/aromatic compound of 7.5. Thus, as can be seen from the enclosed Declaration, conversion of o-xylene and ethylbenzene, selected from alkyl-substituted aromatic compounds having one or two alkyl groups, increased according to increase of HF, while conversion of mesitylene, a polyalkyl-substituted aromatic compound having 3-5 alkyl groups, decreased as HF increased. Moreover, yield of o-xylene increased as HF increased, while yield of mesitylene decreased as HF increased. The yield of ethylbenzene was very low due to low selectivity. Note page 6 of the enclosed Declaration.

In view of the foregoing, it is respectfully submitted that the enclosed Declaration shows that polyalkyl-substituted aromatic compounds having 3-5 alkyl groups operates differently from aromatic compounds substituted with one or two alkyl groups, in formylation reactions corresponding to the present invention; that problems arise with respect to yield and conversion in formylation reactions of polyalkyl-substituted aromatic compounds having 3-5 C₁-C₃ groups; and that such problems are overcome according to the present invention. It is respectfully submitted that Fujiyama, et al. would have neither disclosed nor would have suggested such problem, nor overcoming such problem; and, moreover, it is respectfully submitted that Fujiyama, et al., in expressly teaching a molar ratio of HF of at least 5, would have taught away from the present invention.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application are respectfully requested.

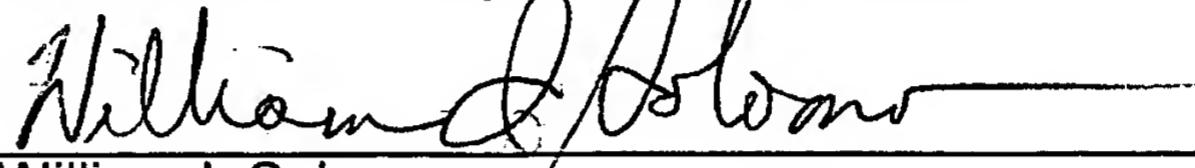
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Respectfully submitted,

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